

MIL-M-38510/106A  
21 December 1977  
SUPERSEDING  
MIL-M-38510/106  
26 December 1973

MILITARY SPECIFICATION

MICROCIRCUITS, LINEAR,  
VOLTAGE FOLLOWER OPERATIONAL AMPLIFIERS  
MONOLITHIC SILICON

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for monolithic silicon, voltage follower operational amplifiers. Three product assurance classes and a choice of case outline and lead finish are provided for each type and are reflected in the complete part number.

1.2 Part number. The complete part number shall be as specified in MIL-M-38510.

1.2.1 Device type. The device type shall be as shown in the following:

<u>Device type</u>	<u>Circuit</u>
01	Voltage follower
02	Voltage follower, high speed
03	Voltage follower, high speed, dual 1/

1.2.2 Device class. The device class shall be the product assurance level as defined in MIL-M-38510.

1.2.3 Case outline. The case outline shall be designated as follows:

<u>Outline letter</u>	<u>MIL-M-38510, appendix C, case outline</u>
C	D-1 (14-lead, 1/4" x 3/4", dual-in-line)
E	D-2 (16-lead, 1/4" x 7/8", dual-in-line)
F	F-5 (16-lead, 1/4" x 3/8", flat-pack)
G	A-1 (8-lead can)
H	F-4 (10-lead, 1/4" x 1/4", flat-pack)

1/ Device type 03 may be monolithic, or may consist of two separate, independent dice.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Rome Air Development Center, RADC (RBRD), Griffiss AFB, NY 13441, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.2.4 Absolute maximum ratings.

Supply voltage range - - - - -  $\pm 18$  Vdc  
 Input voltage range- - - - -  $\pm 15$  Vdc 2/  
 Storage temperature range- - - - -  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$   
 Output short-circuit duration- - - - - Unlimited 3/  
 Lead temperature (soldering, 60 seconds)- - - - -  $300^{\circ}\text{C}$   
 Junction temperature- - - - -  $T_J = 175^{\circ}\text{C}$ 4/

1.2.5 Recommended operation conditions.

Supply voltage range- - - - -  $\pm 5$  to  $\pm 18$  Vdc  
 Ambient temperature range - - - - -  $-55$  to  $+125^{\circ}\text{C}$

1.2.6 Power and thermal characteristics.

<u>Package</u>	<u>Case outline</u>	<u>Maximum allowable power dissipation</u>	<u>Maximum <math>\theta_{J-C}</math></u>	<u>Maximum <math>\theta_{J-A}</math></u>
Dual-in-line	C,E	400 mW @ $T_A = 125^{\circ}\text{C}$	$35^{\circ}\text{C/W}$	$120^{\circ}\text{C/W}$
8 lead can	G	350 mW @ $T_A = 125^{\circ}\text{C}$	$40^{\circ}\text{C/W}$	$150^{\circ}\text{C/W}$
10 lead FP	H	330 mW @ $T_A = 125^{\circ}\text{C}$	$60^{\circ}\text{C/W}$	$150^{\circ}\text{C/W}$
16 lead FP	F	400 mW @ $T_A = 125^{\circ}\text{C}$	$35^{\circ}\text{C/W}$	$120^{\circ}\text{C/W}$

## 2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

## SPECIFICATION

## MILITARY

MIL-M-38510 - Microcircuits, General Specification for.

## STANDARD

## MILITARY

MIL-STD-883 - Test Methods and Procedures for Microelectronics.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

## 3. REQUIREMENTS

3.1 Detail specifications. The individual item requirements shall be in accordance with MIL-M-38510, and as specified herein.

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- 2/ For supply voltages less than  $\pm 15$  Vdc, the absolute maximum input voltage is equal to the supply voltage.  
3/ Short circuit may be to ground or either supply. Rating applied to  $+125^{\circ}\text{C}$  case temperature or  $+75^{\circ}\text{C}$  ambient temperature.  
4/ For short term test (in the specific burn-in and life test configuration, when required and up to 168 hours maximum)  $T_J = 275^{\circ}\text{C}$ .

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and 1.2.3 herein.

3.2.1 Terminal connections. The terminal connections shall be as specified on figure 2.

3.2.2 Schematic circuit. The schematic circuit shall be as specified on figure 3.

3.3 Lead material and finish. Lead material and finish shall be in accordance with MIL-M-38510 (see 6.5).

3.4 Electrical performance characteristics. The following electrical performance characteristics apply over the full operating ambient temperature range of -55° to 125°C and for supply voltages of  $\pm 5$  Vdc to  $\pm 18$  Vdc, unless otherwise specified (see table I).

3.4.1 Offset null circuits. Each amplifier shall be capable of being nulled for  $\pm 7.5$  mV input offset voltage using the following circuit in figure 1.

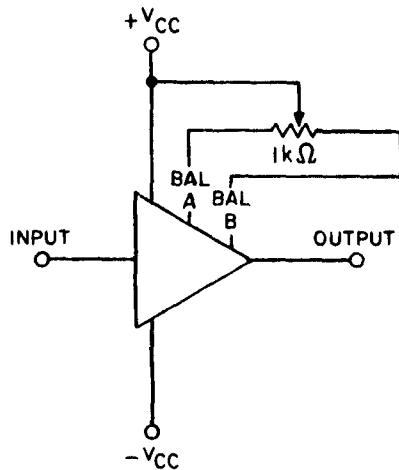


FIGURE 1. Offset null circuit.

3.5 Rebonding. Rebonding shall be in accordance with MIL-M-38510.

3.6 Electrical test requirements. Electrical test requirements shall be as specified in table III for the applicable device type. The subgroups of table III and limits of table IV which constitute the minimum electrical test requirements for screening, qualification, and quality conformance, by device class are specified in table II.

3.7 Marking. Marking shall be in accordance with MIL-M-38510. At the option of the manufacturer, the following marking may be omitted from the body of the micro-circuit, but shall be retained on the initial container.

- a. Country of origin.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/	Device type	Limits 2/		Units
				Min	Max	
Input offset voltage	$V_{IO(1)}$ and $V_{IO(2)}$	$T_A = 25^\circ C$	01	-4.0	+4.0	mV
			02,03	-2.5	+2.5	mV
	$V_{IO(2)}$	$-55^\circ C \leq T_A \leq +125^\circ C$	01	-5.0	+5.0	mV
			02, 03	-3.5	+3.5	mV
Input offset voltage temperature sensitivity	$\Delta V_{IO}$ $\Delta T$	$-55^\circ C \leq T_A \leq 25^\circ C$	01,02,03		15	$\mu V/^\circ C$
		$25^\circ C \leq T_A \leq +125^\circ C$	01,02,03		15	$\mu V/^\circ C$
Adjustment for input offset voltage	$V_{IO(ADJ)}$	$+V_{IO(ADJ)}$	01,02,03	+7.5		mV
		$-V_{IO(ADJ)}$	01,02,03		-7.5	mV
Input bias current	$I_{IB}$	$T_A = 25^\circ C$	01		5	nA
			02,03		3	nA
		$-55^\circ C \leq T_A \leq +125^\circ C$	01		20	nA
			02,03		10	nA
Power supply rejection	+PSR	$\Delta V_{CC} = 8 \text{ Vdc}$	01		-60	dB
			02,03		-70	dB
Supply current	+I <sub>CC</sub>	$T_A = -55^\circ C$ $T_A = +25^\circ C$ $T_A = +125^\circ C$	01,02, 03		8.0	mA
					5.5	
					4.0	
Output resistance	$R_0$	$25^\circ C \leq T_A \leq +125^\circ C$	01,02		2.5	$\Omega$
		$-55^\circ C \leq T_A \leq 25^\circ C$	03		5	$\Omega$
Maximum output voltage swing	$V_{OPP1}$	$R_L = 10 \text{ k}\Omega$ ; Booster open $\pm V_o = \pm 10 \text{ V}$	01,02, 03	20		V
	$V_{OPP2}$	$R_L = 3.3 \text{ k}\Omega$ ; 100 $\Omega$ from booster to $-V_{CC}$ ; $\pm V_o = \pm 10 \text{ V}$	01,02, 03	20		V
Transient response	TR	Figure 9      Rise time	01,02, 03		44	ns
		Figure 9      Overshoot	01,02 03		30	%
Slew rate	SR(+)	Figure 9	01	7		$V/\mu s$
			02,03	20		$V/\mu s$
Large signal voltage gain	$\Delta V(+)$	Figure 8	01,02 03	0.999	1.000	
Output short circuit current (positive output)	$I_{OS}(+)$	$25^\circ C \leq T_A \leq 125^\circ C$	01,02, 03	10	35	mA
		$T_A = -55^\circ C$	01,02, 03	10	40	mA

See footnotes at end of table.

TABLE I. Electrical performance characteristics -Continued.

Test	Symbol	Conditions 1/	Device type	Limits 2/		Units
				Min	Max	
Output short circuit current (negative output)	$I_{OS}(-)$	$25^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$	01,02 03	1.5	10	mA
		$T_A = -55^\circ\text{C}$	01,02, 03	1.3	10	mA
Bandwidth	BW	Figure 9		01,02, 03	8	MHz
Channel separation	CS	Figure 10		03	90	dB

1/ Complete terminal conditions shall be as specified on figure 7, unless otherwise specified.

2/ Limits apply to both halves of device type 03, independently.

TABLE II. Electrical test requirements.

MIL-STD-883 test requirement	Class S devices	Class B devices	Class C devices
Interim electrical parameters (preburn-in) (method 5004)	1	1	None
Final electrical test parameters (Method 5004)	1*, 2, 3, 4, 5, 6	1*, 2, 3, 4, 5, 6	1, 4
Group A test requirements (Method 5005)	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 4, 7
Group C end point electrical parameters (Method 5005)	1, 2, 3, and table IV delta limits	1 and table IV delta limits	1 and table IV delta limits
Additional electrical subgroups for Group C periodic inspections	Not applicable	8	5, 6, 8
Group D end point electrical parameters (Method 5005)	1, 2, 3 and table IV delta limits	1 and table IV delta limits	1 and table IV delta limits

\* PDA applied to subgroup 1 (see 4.3d).

#### 4. QUALITY ASSURANCE PROVISIONS

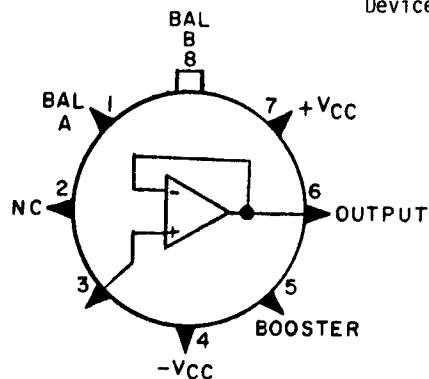
4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-M-38510 and methods 5005 and 5007, as applicable, of MIL-STD-883, except as modified herein.

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

4.3 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to qualification and quality conformance inspection. The following additional criteria shall apply:

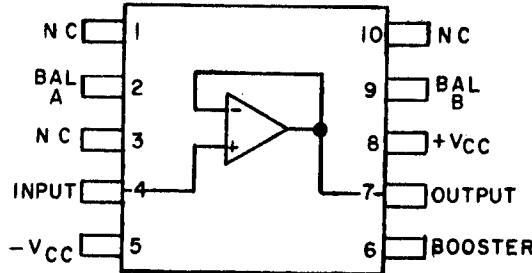
- a. Burn-in (method 1015 of MIL-STD-883).
  - 1. For class S devices: Test condition D using the circuit shown in figure 4.
  - 2. For class B devices: Test condition D using the circuit shown in figure 4, test condition C using the circuit shown in figure 5, or test condition F using the circuit (or equivalent) shown in figure 6 or equivalent.
- b. Reverse bias burn-in (method 1015 of MIL-STD-883). For class S devices only using the circuit shown in figure 5.
- c. Interim and final electrical test parameters shall be as specified in table II.

Device types 01 and 02



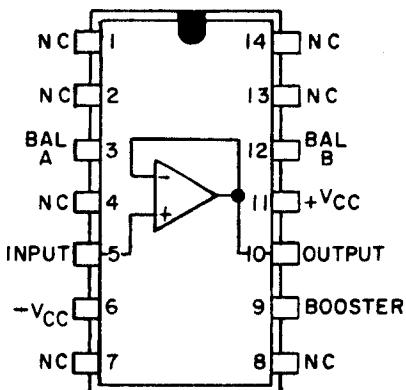
PIN 4 CONNECTED TO CASE  
8-LEAD CAN

#### CASE G



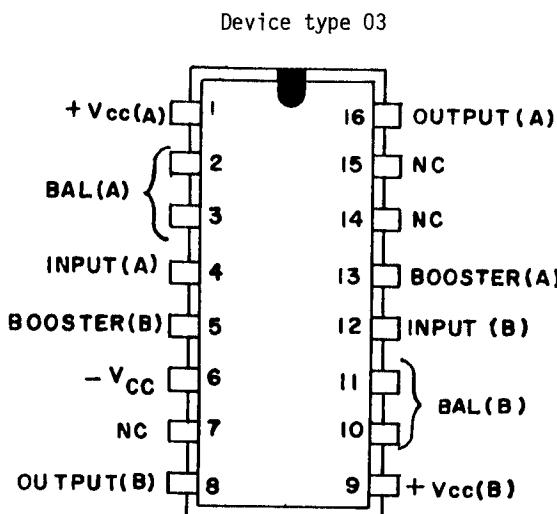
PIN 5 CONNECTED TO BOTTOM OF PACKAGE  
10-LEAD FLAT-PACK

#### CASE H



PIN 6 CONNECTED TO BOTTOM OF PACKAGE  
14-LEAD DUAL-IN-LINE

#### CASE C



16-LEAD DUAL-IN-LINE AND FLAT-PACK

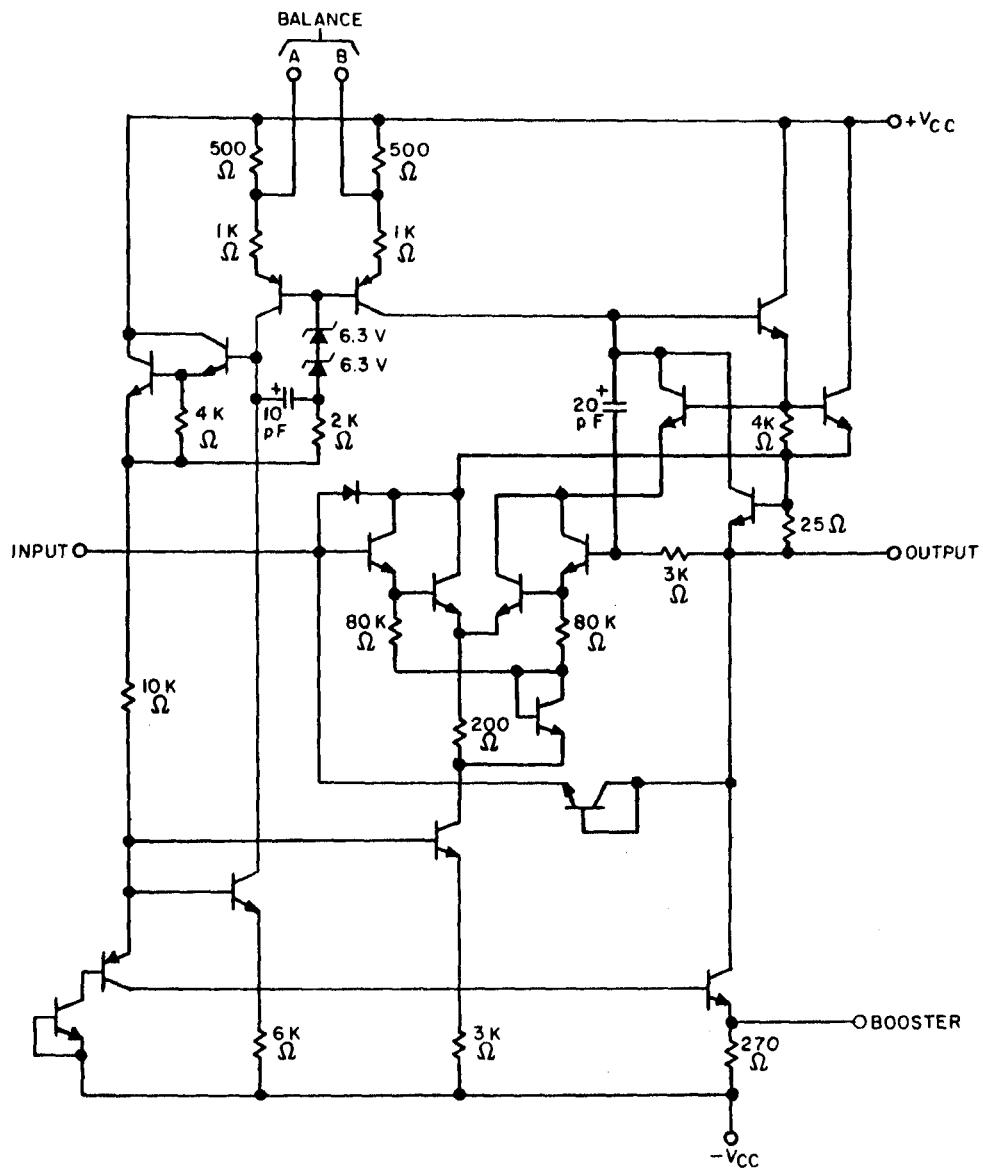
#### CASES E AND F

##### NOTES:

- 1/ +V<sub>cc</sub>(A) and +V<sub>cc</sub>(B) shall not be internally connected, however, external connection is recommended.
- 2/ Pin 6 common to both halves and is connected to the case.

FIGURE 2. Terminal connections.

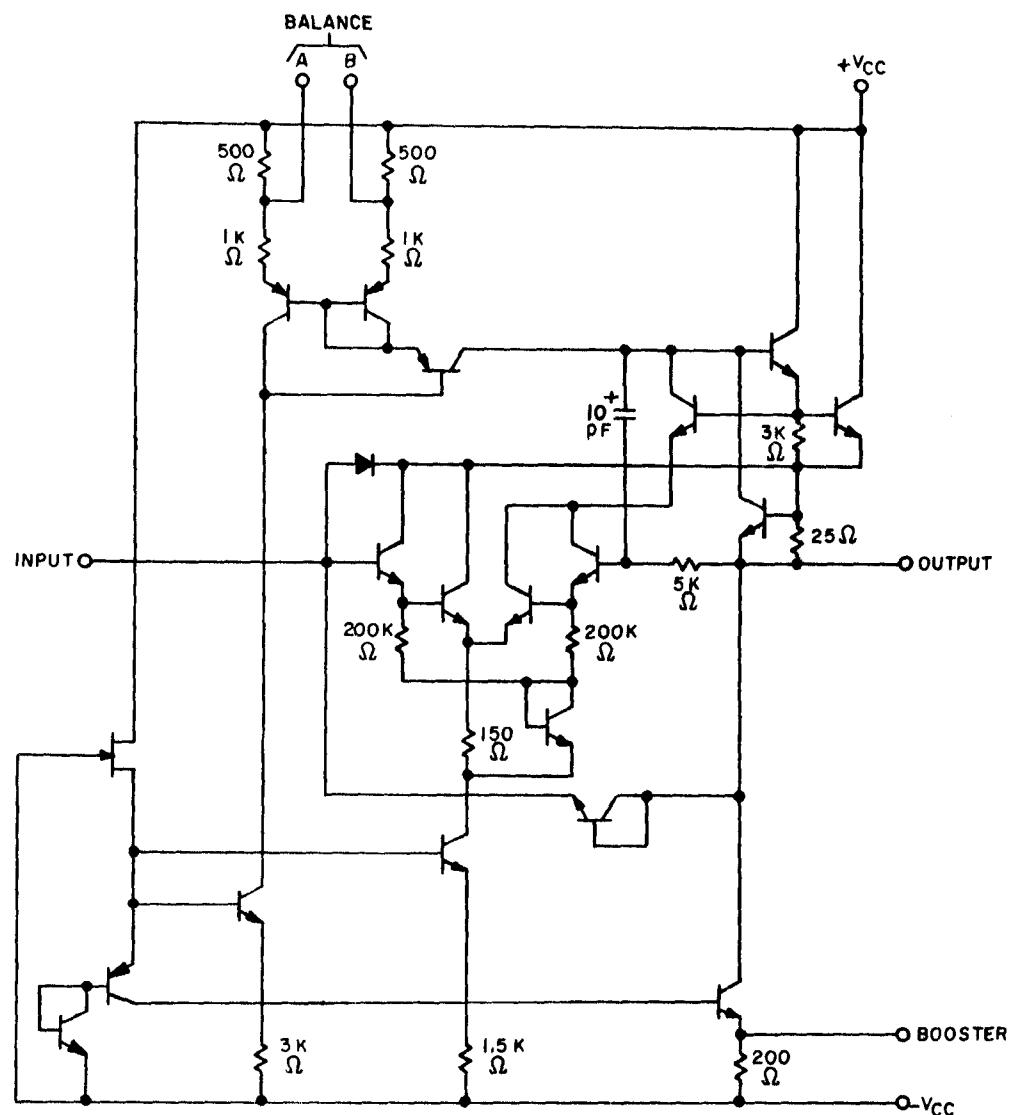
Device type 01



NOTE: All components values are nominal.

FIGURE 3. Schematic circuits.

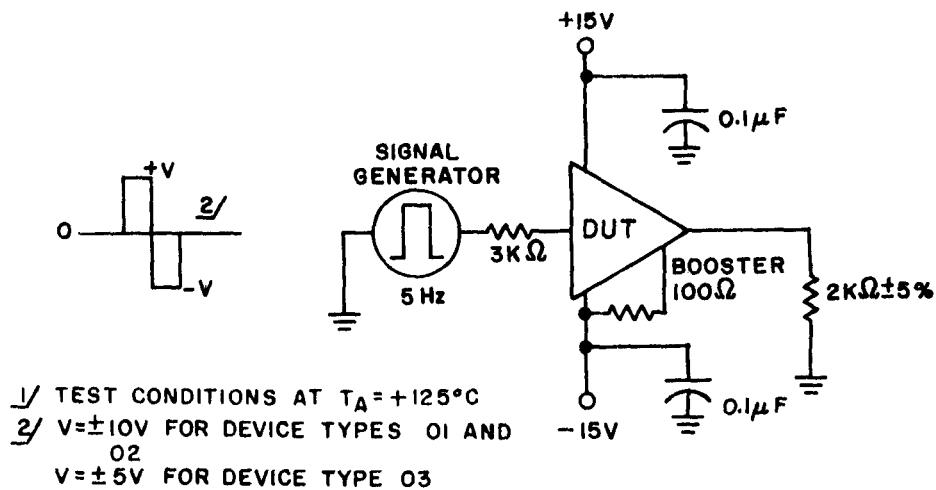
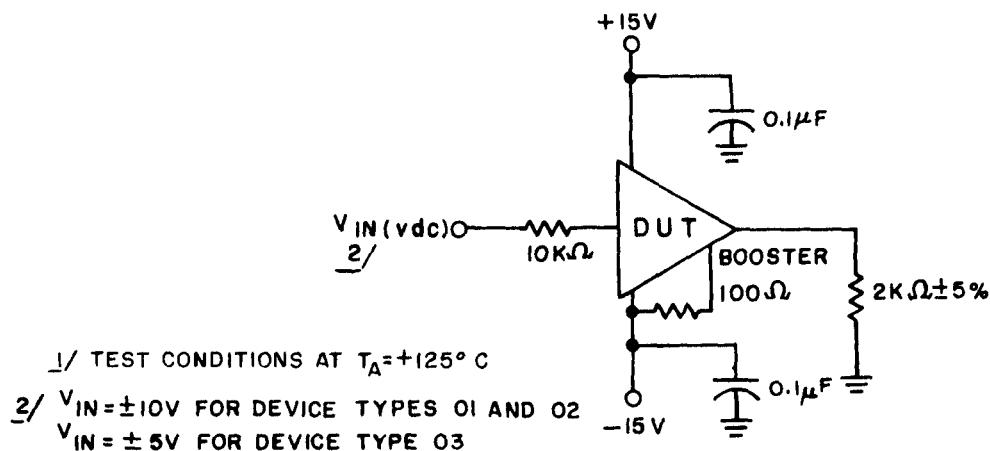
Device type 02

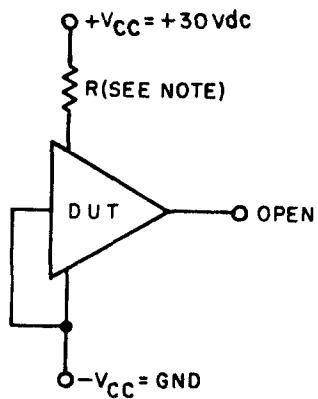


NOTES:

1. All component values are nominal.
2. For device type 03, the circuit shown is for each amplifier.

FIGURE 3. Schematic circuits - Continued.

FIGURE 4. Test circuit, burn-in and operating life test.FIGURE 5. Test circuit, burn-in (steady state power and reverse bias)  
and operating life test.



NOTE: If accelerated, high temperature test conditions are used; the device manufacturer shall ensure that at least 85% of the applied voltage is dropped across the device during test at temperature. The device is not considered functional under accelerated test conditions.

FIGURE 6. Accelerated burn-in and life test circuit.

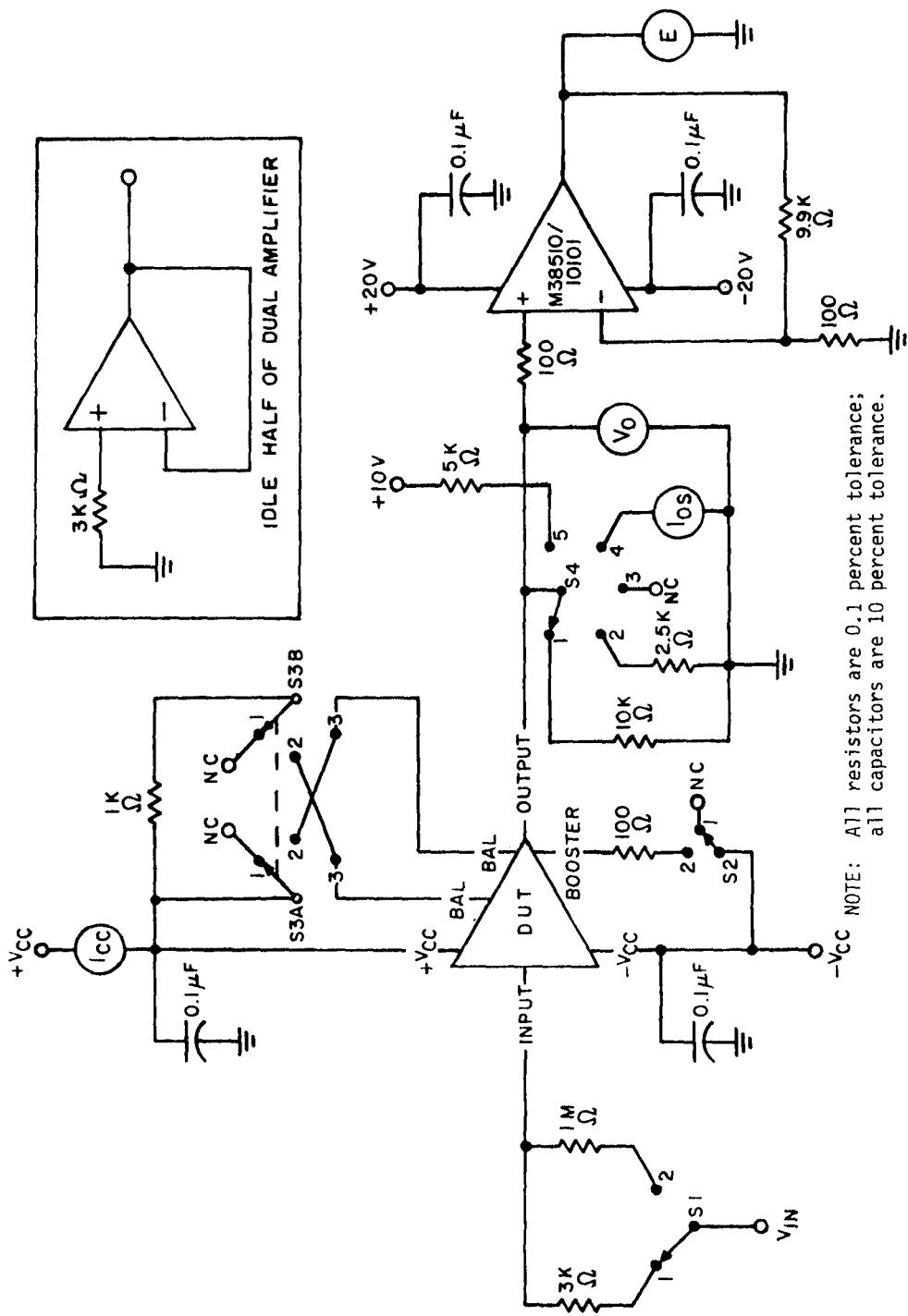


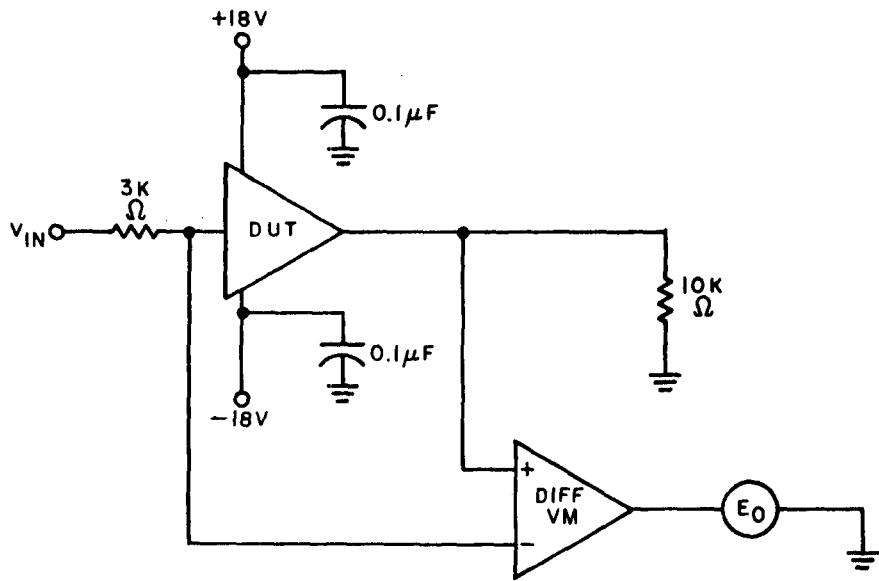
FIGURE 7. Test circuit for static and dynamic tests.

Parameter	Supplies 1/		2/		Switch positions 1/				Measure		Measured parameter		Units
	+V <sub>CC</sub>	-V <sub>CC</sub>	V <sub>IN</sub>		S1	S2	S3	S4	Value	Units	Equation		
V <sub>IO(1)</sub> 3/	+18V	-18V	---		1	1	1	1	E1	mV	V <sub>IO</sub> = E1/100	mV	
V <sub>IO(2)</sub>	+5V	-5V	---		1	1	1	1	E2	mV	V <sub>IO</sub> = E2/100	mV	
V <sub>IO(ADJ) +</sub>	+18V	-18V	---		1	1	2	1	E3	mV	V <sub>IO(ADJ)+</sub> = (E1-E5)/100	mV	
V <sub>IO(ADJ) -</sub>	+18V	-18V	---		1	1	3	1	E4	mV	V <sub>IO(ADJ)-</sub> = (E1-E4)/100	mV	
I <sub>IB(+)</sub>	+18V	-18V	---		2	1	1	1	E5	mV	I <sub>IB</sub> = (E1-E5)/100	dB	
R <sub>O</sub>	+18V	-18V	---		1	1	1	5	E6	mV	R <sub>O</sub> = (E6-E1)/200	dB	
+PSR 3/	+10V	-18V	---		1	1	1	1	E7	mV	+PSR = 20 log <sub>10</sub> E1-E2/5	dB	
-PSR 3/	+18V	-10V	---		1	1	1	1	E8	mV	-PSR = 20 log <sub>10</sub> E1-E8/5	dB	
+I <sub>CC</sub>	+18V	-18V	---		1	1	1	3	I <sub>CC</sub>	mA	+I <sub>CC</sub> = I <sub>CC</sub>	mA	
+V <sub>OPP1</sub>	+18V	-18V	4/		1	1	1	(V <sub>O</sub> ) <sub>1</sub>	V		V <sub>OPP1</sub> = (V <sub>O</sub> ) <sub>1</sub> - (V <sub>O</sub> ) <sub>2</sub>	V	
-V <sub>OPP1</sub>	+18V	-18V	4/		1	1	1	(V <sub>O</sub> ) <sub>2</sub>	V			V	
+V <sub>OPP2</sub>	+18V	-18V	4/		1	2	1	(V <sub>O</sub> ) <sub>3</sub>	V		V <sub>OPP2</sub> = (V <sub>O</sub> ) <sub>3</sub> - (V <sub>O</sub> ) <sub>4</sub>	V	
-V <sub>OPP2</sub>	+18V	-18V	4/		1	2	1	(V <sub>O</sub> ) <sub>4</sub>	V			V	
I <sub>OS(+)</sub>	+18V	-18V	+15V		1	1	4	I <sub>OS1</sub>	mA	I <sub>OS(+)</sub> = I <sub>OS1</sub>	mA		
I <sub>OS(-)</sub>	+18V	-18V	-15V		1	1	4	I <sub>OS2</sub>	mA	I <sub>OS(-)</sub> = I <sub>OS2</sub>	mA		

1/ Precautions shall be taken to prevent damage to the D.U.T. during insertion into socket and change of switch positions (e.g. disable voltage supplies, current limit  $\pm V_{SO}$ , etc.).

2/ All supply voltages must be held to within 0.1 V of the specified value.  
 3/ E1, E7, and E8 shall be measured to four place accuracy to provide required resolution in PSR.  
 4/ VIN shall be increased to steps of 0.10 volt, starting at ±9.00 volts as applicable, until the increase in the output is less than 0.08 volt per 0.10 volt increase in the input. The last value of  $V_o$  shall be used to calculate  $V_{OPP}$ .

FIGURE 7. Test circuit for static and dynamic tests (continued).



## NOTES:

1. The differential voltmeter shall have a common mode rejection equal to or greater than 100 dB and a maximum common mode input range equal to or greater than  $\pm 15$  V.
2. To calculate voltage gain, use the following procedure:

Step	$V_{IN}$	Measure	Equation
1	0 V	$E_{01}$	
2	+10 V	$E_{02}$	$A_{V+} = 1 - \frac{(E_{01} - E_{02})}{10}$
3	-10 V	$E_{03}$	$A_{V-} = 1 - \frac{(E_{03} - E_{02})}{10}$

3. Test duration is 10 ms.

FIGURE 8. Test circuit for measuring large signal voltage gain.

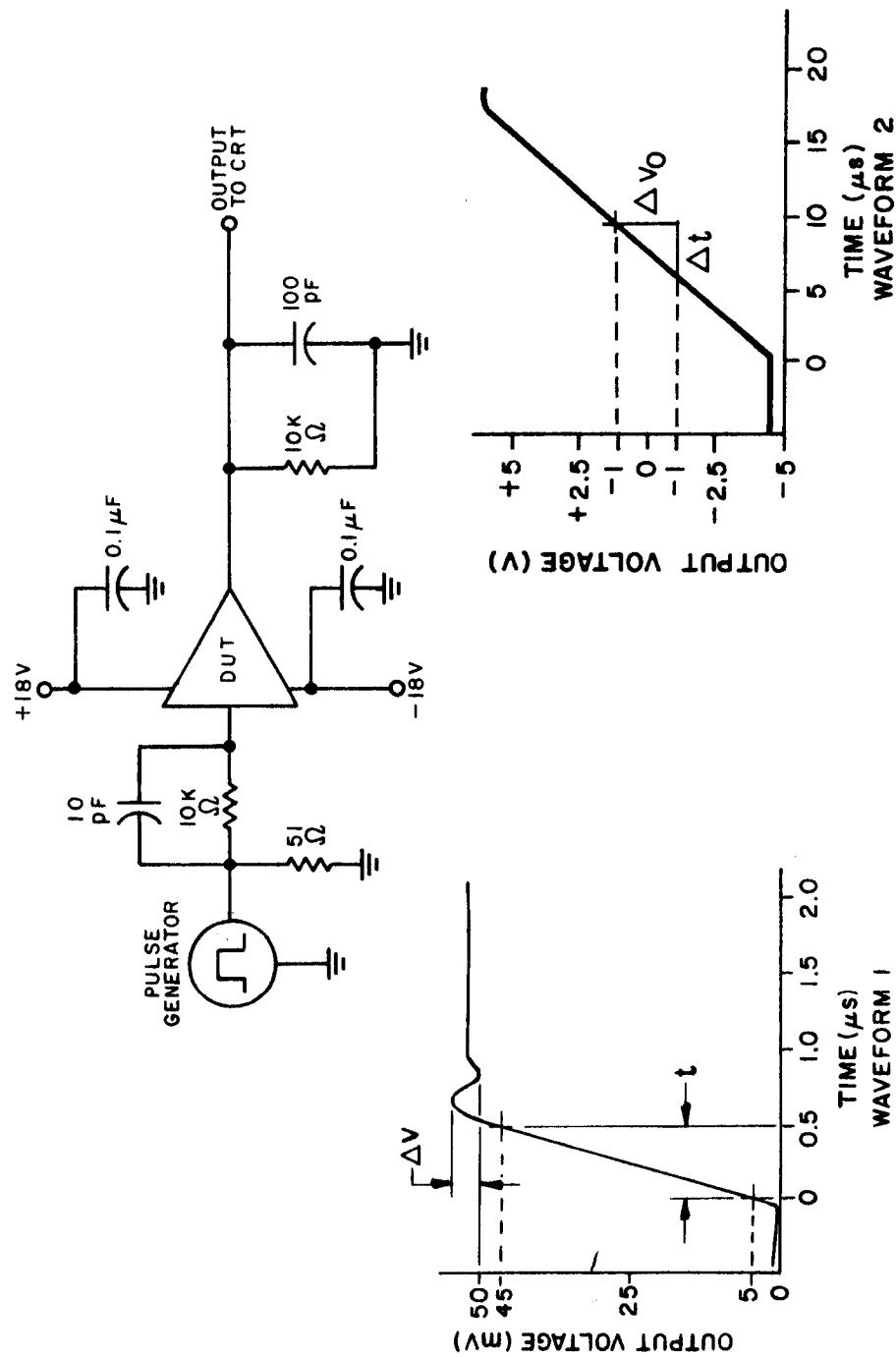
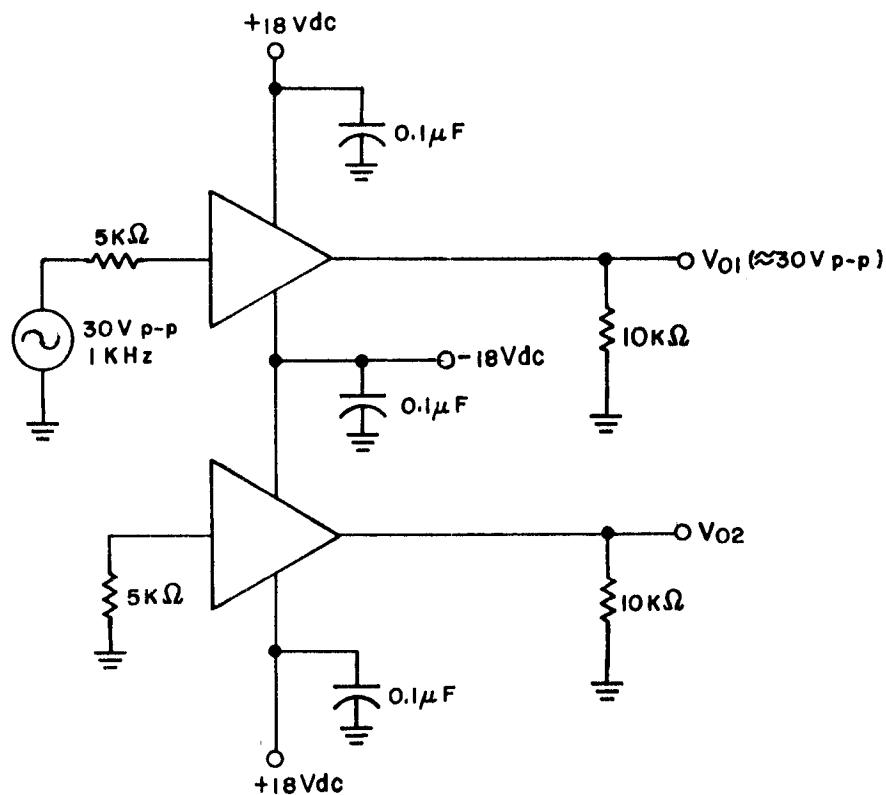


FIGURE 9. Transient response test circuit.

Parameter	Pulse Generator	Measure	Equation	Units
TR; Risetime	10 ns rise time maximum +50 mV amplitude	$t \text{ (}\mu\text{s)}$ (see waveform 1)	Rise item = $t$	$\mu\text{s}$
TR: Overshoot		$\Delta V \text{ (mV)}$ (see waveform 1)	Overshoot = $2 (\Delta V)$	%
SR(+) Slew rate	10 ns rise time maximum, -5 V to +5 V step	$\Delta V_0 \text{ (Volts), } \Delta t \text{ (}\mu\text{s)}$ (see waveform 2)	$SR(+)$ = $\Delta V_0 / \Delta t$	$V/\mu\text{s}$
SR(-) Slew rate	100 ns rise time maximum, +5 V to -5 V step	$\Delta V_0 \text{ (Volts), } \Delta t \text{ (}\mu\text{s)}$	$SR(-)$ = $\Delta V_0 / \Delta t$	$V/\mu\text{s}$
BW (small signal)		Calculate	$BW = \frac{0.35}{Risetime(\mu\text{s})}$	MHz

NOTE: Resistor tolerances are 1 percent; capacitor tolerances are 10 percent.

FIGURE 9. Transient response test circuit - Continued.



NOTES:

1. Channel separation =  $20 \log \frac{V_{01}}{V_{02}}$  (dB)
2.  $V_{02}$  measured is A. C.

FIGURE 10. Test circuit for channel separation (device type 03 only).

TABLE III. Group A inspection.

Subgroup	Symbol	MIL-STD-883 method	Test	Condition $\frac{1}{\underline{I}}$	Device type	Limits Min	Limits Max	Units
$T_A = 25^\circ C$	$V_{IO(1)}$	4001	1	$R_S = 3 k\Omega; \pm V_{CC} = \pm 18 V$		01	-4.0	+4.0 mV
	$V_{IO(2)}$	4001	2	$R_S = 3 k\Omega; \pm V_{CC} = \pm 5V$		02, 03	-2.5	+2.5 mV
	$V_{IO(ADJ)+}$	3		$R_S = 3 k\Omega; \pm V_{CC} = \pm 18 V$		01	-4.0	+4.0 mV
	$V_{IO(ADJ)-}$	4		$R_S = 3 k\Omega; \pm V_{CC} = \pm 18 V$		02, 03	-2.5	+2.5 mV
	$I_{IB}$	4001	5	$\pm V_{CC} = \pm 18V$		01, 02,	+7.5	
	$+PSR$	4003	6	$\Delta(+V_{CC}) = 8 V_{dc}$		03	-7.5	mV
	$-PSR$	4003	7	$\Delta(-V_{CC}) = 8 V_{dc}$		01, 02,	-7.5	mV
	$+I_{CC}$	3005	8	$\pm V_{CC} = \pm 18 V$		02, 03	-60	dB
	$R_O$	9		$\pm V_{CC} = \pm 18 V$		02, 03	-70	dB
	$I_{OS(+)}$	3011	10	$V_{IN} = +15V; \pm V_{CC} = \pm 18V$		01, 02,	-70	dB
$\rightarrow$		$I_{OS(-)}$	3011	$V_{IN} = -15V; \pm V_{CC} = \pm 18V$		01, 02,	-70	dB
$T_A = 125^\circ C$	$V_{IO(1)}$	12		$R_S = 3 k\Omega; \pm V_{CC} = \pm 18V$		01	-5.0	+5.0 mV
	$V_{IO(2)}$	13		$R_S = 3 k\Omega; \pm V_{CC} = \pm 5V$		02, 03	-3.5	+3.5 mV
	$\frac{\Delta V_{IO}}{\Delta T}$	4001	14	$[V_{IO(1)}(\text{test } 12) - V_{IO(1)}(\text{test } 1)]/100^\circ C$		01	-3.5	+3.5 mV
						02, 03	15	$\mu V/\text{ }^\circ C$

TABLE III. Group A inspection -Continued.

Subgroup	Symbol	MIL-STD-883 method	Test	Condition 1 /		Device type	Limits		Units
				Min	Max		Min	Max	
$T_A = +125^\circ C$	$V_{IO(ADJ)+}$		15	$R_s = 3 k\Omega$ ; $\pm V_{CC} = \pm 18V$		01,02, 03	+7.5		mV
	$V_{IO(ADJ)-}$		16	$R_s = 3 k\Omega$ ; $\pm V_{CC} = \pm 18V$		01,02, 03	-7.5		mV
$T_{IB}$	4001		17	$\pm V_{CC} = \pm 18V$		01 02,03		20 10	nA
$+PSR$	4003		18	$\Delta(+V_{CC}) = 8 V_{dc}$		01 02,03	-60 -70		dB
$-PSR$	4003		19	$\Delta(-V_{CC}) = 8 V_{dc}$		01,02, 03	-70		dB
$+I_{CC}$	3005		20	$\pm V_{CC} = \pm 18V$		01,02, 03	4.0		mA
$R_o$			21	$\pm V_{CC} = \pm 18V$		01,02, 03	2.5		Ω
$I_{OS}(+)$	3011		22	$V_{IN} = +15V$ ; $\pm V_{CC} = \pm 18V$		01,02, 03	10	35	mA
$I_{OS}(-)$	3011		23	$V_{IN} = -15V$ ; $\pm V_{CC} = \pm 18V$		01,02, 03	1.5	10	mA
$T_A = -55^\circ C$	$V_{IO(1)}$	4001	24	$R_s = 3 k\Omega$ ; $\pm V_{CC} = \pm 18V$		01 02,03	-5.0 -3.5	+5.0 +3.5	mV
	$V_{IL(2)}$	4001	25	$R_s = 3 k\Omega$ ; $\pm V_{CC} = \pm 5V$		01 02,03	-5.0 -3.5	+5.0 +3.5	mV
	$\frac{\Delta V_{IO}}{\Delta T}$	4001	26	$[V_{IO(1)}(\text{Test 1}) - V_{IO(1)}(\text{Test 24})]/80^\circ C$		01, 02,03		15	µV/°C
	$V_{IO(ADJ)+}$		27	$R_s = 3 k\Omega$ ; $\pm V_{CC} = \pm 18 V$		01,02, 03	+7.5		mV
	$V_{IO(ADJ)-}$		28	$R_s = 3 k\Omega$ ; $\pm V_{CC} = \pm 18V$		01,02, 03	-7.5		mV

TABLE III. Group A Inspection -Continued.

Subgroup	Symbol	MIL-STD-883 method	Test	Condition 1/	Device type	Limits 3/ Min	Limits 3/ Max	Units
$T_A = -55^\circ C$	$I_{IB}$	4001	29	$\pm V_{CC} = \pm 18V$		01 02, 03	20 10	nA
	+PSR	4003	30	$\Delta(+V_{CC}) = 8$ Vdc		01 02, 03	-60 -70	dB
	-PSR	4003	31	$\Delta(-V_{CC}) = 8$ Vdc		01, 02, 03	-70	dB
	+I <sub>CC</sub>	3005	32	$\pm V_{CC} = \pm 18V$		01, 02, 03	8.0	mA
	R <sub>O</sub>		33	$\pm V_{CC} = \pm 18V$		01, 02, 03	5	$\Omega$
	I <sub>OS(+)</sub>	3011	34	$V_{IN} = +15V; \pm V_{CC} = \pm 18V$		01, 02 03	10	40
	I <sub>OS(-)</sub>	3011	35	$V_{IN} = -15V; \pm V_{CC} = \pm 18V$		01, 02, 03	1.3	10
	A <sub>V+</sub>	4004	36	Figure 8; $\pm V_{CC} = \pm 18V$		01, 02, 03	0.999	1.000
	A <sub>V-</sub>	4004	37	Figure 8; $\pm V_{CC} = \pm 18V$		01, 02, 03	0.999	1.000
	V <sub>OPP1</sub>	4004	38	$R_L = 10 k\Omega$ ; booster open; $\pm V_o = \pm 10V$		01, 02, 03	20	V
$T_A = 25^\circ C$	V <sub>OPP2</sub>	4004	39	$R_L = 3.3 k\Omega; \pm V_o = \pm 10V$ ; 100Ω from booster to $V_{CC}$		01, 02, 03	20	V
	A <sub>V+</sub>	4004	40	Figure 8; $\pm V_{CC} = \pm 18V$		01, 02, 03	0.999	1.000
	A <sub>V-</sub>	4004	41	Figure 8; $\pm V_{CC} = \pm 18V$		01, 02 03	0.999	1.000
	V <sub>OPP1</sub>	4004	42	$R_L = 10 k\Omega$ ; booster open; $\pm V_o = \pm 10V$		01, 02, 03	20	V
	V <sub>OPP2</sub>	4004	43	$R_L = 3.3 k\Omega; \pm V_o = 10V$ ; 100Ω from booster to $-V_{CC}$		01, 02, 03	20	V

See footnotes at end of table.

TABLE III. Group A inspection -Continued.

Subgroup	Symbol	MIL-STD-883 method	Test	Condition <u>1/</u>	Device type	Limits <u>2/</u> Min.	Limits <u>2/</u> Max	Unit
7 $T_A = +25^\circ C$	TR rise time	48	Figure 9		01,02, 03		44	ns
	TR overshoot	49	Figure 9		01,02, 03		30	%
	SR(+)	4002	50	Figure 9	01 02,03	7 20		V/ $\mu$ s
	SR(-)	4002	51	Figure 9	01 02,03	7 20		V/ $\mu$ s
	BW		52	Figure 9	01,02, 03		8	MHz
	CS		53	Figure 10	03	90		dB
8	Repeat subgroup 7 at $T_A = +125^\circ C$ and $T_A = -55^\circ C$ . (Test numbers 54 - 65)							

1/ Complete terminal conditions shall be as specified on figure 7, unless otherwise specified.  
2/ Limits apply to both halves of device type 03, independently.

- d. Percent defective allowable (PDA) - The PDA for class S devices shall be as specified in MIL-M-38510. The PDA is specified as 10 percent for class B devices based on failures from group A, subgroup 1 test after cooldown as final electrical test in accordance with method 5004 of MIL-STD-883, and with no intervening electrical measurements. If interim electrical parameter tests are performed prior to burn-in, failures resulting from per burn-in screening may be excluded from the PDA. If interim electrical parameter tests prior to burn-in are omitted, then all screening failures shall be included in the PDA. The verified failures of group A, subgroup 1 after burn-in in that lot shall be used to determine the percent defective for that lot, and the lot shall be accepted or rejected based on the PDA for the applicable device class.

**4.4 Quality conformance inspection.** Quality conformance inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

**4.4.1 Group A inspection.** Group A inspection shall be in accordance with table I of method 5005 of MIL-STD-883 and as follows:

- a. Subgroups 9, 10, and 11 shall be omitted.
- b. Tests shall be as specified in table II.

**4.4.2 Group B inspection.** Group B inspection shall be in accordance with table II of method 5005 of MIL-STD-883 and as follows:

- a. End point electrical parameters shall be as specified in table II.
- b. Life test for class S shall be performed as specified in subgroup 5 of table IIa using circuit shown in figure 6 or equivalent.

**4.4.3 Group C inspection.** Group C inspection shall be in accordance with table III of method 5005 of MIL-STD-883 and as follows:

- a. End point electrical parameters shall be as specified in table II herein.
- b. Life tests for class B and C (method 1005 of MIL-STD-883): Test condition C only using the circuits shown in figure 7. Accelerated test condition shall not be used.
- c. Constant acceleration (method 2001 of MIL-STD-883). Test condition B shall be used for case Y.

**4.4.4 Group D inspection.** Group D inspection shall be in accordance with table IV of method 5005 of MIL-STD-883. End points shall be as specified in table II.

**4.5 Methods of inspection.** Methods of inspection shall be as specified in the appropriate tables. Electrical test circuits as prescribed herein or in the referenced test methods of MIL-STD-883 shall be acceptable. Other test circuits shall require the approval of the qualifying activity.

**4.5.1 Voltage and current.** All voltage values given, except the input offset voltage (or differential voltage) are referenced to the external zero reference level of the supply voltage. Currents given are conventional current and positive when flowing into the referenced terminal.

**4.5.2 Life test cooldown procedure.** When devices are measured at 25°C following application of the operating life or burn-in test condition, they shall be cooled to room temperature prior to removal of the bias.

TABLE IV. Groups C and D end point electrical parameters.  
 $(T_A = 25^\circ\text{C}; \pm V_{CC} = \pm 18 \text{ V})$

Test	Device type 01		Device type 02 and 03	
	Limit	Delta	Limit	Delta
$V_{IO}$	$\pm 4 \text{ mV}$	$\pm 1 \text{ mV}$	$\pm 2.5 \text{ mV}$	$\pm 0.5 \text{ mV}$
$I_{IB}$	$\pm 5 \text{ nA}$	$\pm 1 \text{ nA}$	$3 \text{ nA}$	$\pm 1 \text{ nA}$
$I_{CC}$	$5.5 \text{ mA}$	$\pm 10\%$	$5.5 \text{ mA}$	$\pm 10\%$

4.6 Inspection of packaging. The inspection of packaging shall be in accordance with MIL-M-38510, except that the rough handling test shall not apply.

## 5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

## 6. NOTES

6.1 Notes. The notes specified in MIL-M-38510 are applicable to this specification.

6.2 Intended use. Microcircuits conforming to this specification are intended for use for Government microcircuit applications (original equipment) and logistic purposes.

6.3 Ordering data. The contract should specify the following:

- a. Complete part number (see 1.2).
- b. Requirements for delivery of one copy of the quality conformance inspection data pertinent to the device inspection lot to be supplied with each shipment by the device manufacturer, if applicable.
- c. Requirement for certificate of compliance, if applicable.
- d. Requirements for notification of change of product or process to procuring activity in addition to notification to the qualifying activity, if applicable.
- e. Requirements for failure analysis (including required test condition of method 5003), corrective action and reporting of results, if applicable.
- f. Requirements for quality assurance options.
- g. Requirements for carriers, special lead lengths or lead forming, if applicable. These requirements shall not affect the part number. Unless otherwise specified, these requirements will not apply to direct purchase by or direct shipment to the Government.
- h. Requirement for JAN marking.

6.4 Abbreviations, symbols, and definitions used herein are defined in MIL-STD-1313 and MIL-STD-1331.

6.5 Logistic support. Lead materials and finishes (see 3.3) are interchangeable. Unless otherwise specified, microcircuits procured for Government logistic support will be procured to device class B (see 1.2.2), lead material and finish C (see 3.3). Longer length leads and lead forming shall not affect the part number.

6.6 Substitutability. Microcircuits covered by this specification will replace the following commercial device types:

<u>Device type</u>	<u>Commercial type</u>
01	LM102
02	LM110
03	LH2110

Custodians:

Army - EL  
Navy - EC  
Air Force - 17

Review activities:

Army - EL, MI  
Navy - EC, SH  
Air Force - 11, 17, 99  
DLA - ES  
NASA - NA

User activities:

Army - SM, MU, WC  
Navy - CG, MC, AS, OS  
Air Force - 19

Preparing activity:

Air Force - 17

Agent:

DLA - ES/rfg

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